AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): A frequency error detection apparatus based on histogram information on an input signal, comprising:

an analog-to-digital (A/D) converter for sampling and converting an analog signal inputted to an electronic device requiring frequency synchronization, into digital values comprising positive and negative signs;

a zero crossing point detector for detecting sign changes of the digital values, and detecting zero crossing points at which signs of the digital values change;

a period information detector for detecting a period information which is a number of the digital values corresponding to a periodic signal, wherein the periodic signal is a signal between two of the detected zero crossing points;

a histogram information calculator for counting a number of detections of the period information, and calculating histogram information of the period information for periodic signals; and

a frequency error calculator for detecting a difference between the histogram information and a reference histogram information of a signal frequency-synchronized with the electronic

device, and calculating a frequency error value (FE) ~~through a predetermined calculation process~~ based on the difference.

2. (currently amended): The frequency error detection apparatus as claimed in claim 1, further comprising a zero crossing point counter~~/comparator~~ for counting a number of the zero crossing points, and controlling the zero crossing point detector based on whether the number of the zero crossing points is equal to a target number of zero crossing points set for frequency error detections,

wherein the zero crossing point detector stops detecting the zero crossing points upon receiving a control signal from the zero crossing point counter~~/comparator~~ if the number of the zero crossing points is equal to the target number of the zero crossing points.

3. (currently amended): The frequency error detection apparatus as claimed in claim 2, further comprising a feedback part for calculating and outputting to the zero crossing point counter~~/comparator~~ the number of zero crossing points based on the frequency error value.

4. (original): The frequency error detection apparatus as claimed in claim 3, wherein the feedback part includes:

an error detection mode mapping unit for mapping and detecting an error detection mode of plural error detection modes in correspondence to the frequency error value; and

a target number assignment unit for assigning the target number of the zero crossing points based on the error detection mode.

5. (original): The frequency error detection apparatus as claimed in claim 4, wherein the plural error detection modes comprise a stabilization mode and a stable mode, the stabilization mode assigning the target number of the zero crossing points to be lower than a first predetermined number for fast frequency error value detections when the frequency error value is above a predetermined error value, the stable mode assigning the target number of the zero crossing points to be higher than a second predetermined number for an accuracy of the frequency error value when the frequency error value is below the predetermined error value.

6. (original): The frequency error detection apparatus as claimed in claim 1, wherein the frequency error calculator performs calculations based on a period information corresponding to an average value of the reference histogram information and maximum period information of the reference histogram information.

7. (original): The frequency error detection apparatus as claimed in claim 6, wherein the frequency error value is calculated as follows:

$$FE = \left[-\sum_{i=1}^{p} (ref_i - rec_i) + \sum_{i=p+1}^{q} (ref_i - rec_i) \right] / N \times 100,$$

where p denotes the period information corresponding to the average value of the reference histogram information, q denotes the maximum period information in the reference histogram information, ref_i denotes a number of detections of an i^{th} period information in the reference histogram information, rec_i denotes the number of detections of the i^{th} period information in the histogram information, and N denotes total digital values used in calculating the frequency error value.

8. (currently amended): A frequency error detection method based on histogram information on an input signal, comprising:

sampling and converting an analog signal inputted to an electronic device requiring frequency synchronization into digital values having positive and negative signs;

first detecting sign changes of the digital values, and detecting zero crossing points at which signs of the digital values change;

second detecting a period information which is a number of the digital values corresponding to a periodic signal, wherein the periodic signal is a signal between two of the detected zero crossing points;

first counting a number of detections of the period information, and calculating histogram information of the period information for periodic signals; and

third detecting a difference between the histogram information and a reference histogram information of a signal frequency-synchronized with the electronic device, and calculating a frequency error value (FE) ~~through a predetermined calculation process~~ based on the difference.

9. (original): The frequency error detection method as claimed in claim 8, further comprising second counting a number of the zero crossing points, and controlling the first detecting based on whether the number of the zero crossing points is equal to a target number of zero crossing points set for frequency error detections, wherein the first detecting stops detecting the zero crossing points if the number of the counted zero crossing points is equal to the target number of the zero crossing points.

10. (currently amended): The frequency error detection method as claimed in claim 9, further comprising first calculating and applying the second counting <u>of</u> the target number of the zero crossing points based on the frequency error value.

11. (original): The frequency error detection method as claimed in claim 10, wherein the first calculating and applying comprises:

mapping and detecting an error detection mode of plural error detection modes in correspondence to the frequency error value; and

second calculating the target number of the zero crossing points based on the error detection mode.

12. (original): The frequency error detection method as claimed in claim 11, wherein the plural error detection modes comprise a stabilization mode and a stable mode, the stabilization mode assigning the target number of the zero crossing points to be lower than a first predetermined number for fast frequency error value detections when the frequency error value is above a predetermined error value, the stable mode assigning the number of the zero crossing points to be higher than a second predetermined number for an accuracy of the frequency error value when the frequency error value is below the predetermined error value.

13. (original): The frequency error detection method as claimed in claim 8, wherein the third detecting performs calculations based on a period information corresponding to an average value of the reference histogram information and maximum period information of the reference histogram information.

14. (original): The frequency error detection method as claimed in claim 13, wherein the frequency error value is calculated as follows:

$$FE = \left[-\sum_{i=1}^{p} (ref_i - rec_i) + \sum_{i=p+1}^{q} (ref_i - rec_i) \right] / N \times 100,$$

where p denotes the period information corresponding to the average value of reference histogram information, q denotes the maximum period information in the reference histogram information, ref_1 denotes a number of detections of an i^{th} period information in the reference histogram information, rec_i denotes the number of detections of the i^{th} period information in the histogram information, and N denotes total digital values used in calculating the frequency error value.